

'Superbugs' study reveals complex picture of *E. coli* bloodstream infections

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Escherichia coli. Credit: Rocky Mountain Laboratories, NIAID, NIH

The first large-scale genetic study of *Escherichia coli* (*E. coli*) cultured from patients with bloodstream infections in England showed that drug resistant 'superbugs' are not always out-competing other strains.

Research by the Wellcome Trust Sanger Institute and their collaborators showed that new types of *E. coli* occur frequently, but unlike in some other infections, drug-resistant strains do not become a dominant cause of infection.

Published today in *Genome Research*, the study examined a large collection of *E. coli* isolated from patients with bloodstream infection over more than a decade, some of which were resistant to numerous antibiotics while others were not. The researchers found that infection was caused by more than 200 different types of *E. coli*. New strains including multidrug resistant *E. coli* were seen to emerge within the collection over time, but these quickly reached a balance with other strains in the population rather than increasing over time.

Despite being a very common bacterium that is carried naturally in the human digestive tract, *E. coli* are also the leading cause of [bloodstream infections](#). There were 35,676 cases in England in 2014, which often result from spread of infection from the urinary or gastrointestinal tract.

Certain strains of *E. coli* have been extensively studied, like the 'superbug' strain ST131 which is resistant to multiple antibiotics. But this study took a different approach - rather than just focusing on [antibiotic-resistant strains](#), the study tapped into an unbiased collection of 1509 *E. coli*, the majority of which were from the British Society of Antimicrobial Chemotherapy Bacteraemia Surveillance programme collected over 11 years from across England. Using whole genome sequencing, the researchers discovered 228 different strains of *E. coli* in this collection.

The study captured the year (2002) in which ST131 emerged in England. Within a short space of time, the number of ST131 isolates reached an equilibrium with other types. Around the same time, another type (ST69, not a multidrug resistant strain) also emerged, and again quickly reached

an equilibrium within the overall population.

Prof Sharon Peacock, from the Wellcome Trust Sanger Institute and London School of Hygiene & Tropical Medicine, said: "These findings suggest that the emergence of new types of *E. coli* is not uncommon, and is necessarily followed by successful competition with other types to become a dominant cause of infection in humans. The reason for this equilibrium may relate to the fact that all bacteria are constantly competing with others to survive in places where they are carried, such as the gut."

The study found that five strains made up over half of the isolate collection. The 'superbug' ST131 was the second most common strain, with the antibiotic-susceptible strain ST73 the most frequently found. The researchers found that the different strains carried different sets of genes that could underlie their success. Many of these were virulence genes that enabled them to survive in the gut or urinary tract, but some were genes that allowed them to compete better with other bacteria, either by scavenging nutrients, or by directly killing their competitors.

Dr Julian Parkhill, from the Sanger Institute, said: "Our study indicates that there are many reasons for the success of different strains of *E. coli*, and these include competition between bacteria, as well as interaction with the human host and antibiotic resistance. This suggests that the ultimate source of *E. coli* causing bloodstream infections is the diverse bacterial population in the wider community."

The diversity of *E. coli* contrasts with another bacterium causing common hospital infection, methicillin-resistant *Staphylococcus aureus* (MRSA). This is a multi-drug resistant bacterium, with one strain of MRSA dominating at any one time. This organism is transmitted from patient to patient within the hospital setting, and reducing hospital transmission has been shown to help prevent MRSA [infection](#). Further

research is needed but this study suggests that a different strategy may be needed to help reduce *E. coli* blood infections.

Tim Jinks, Head of Drug-Resistant Infections at Wellcome, said: "*E. coli* are the leading cause of bloodstream infections and this study helps illustrate the incredible complexity of the acquisition and spread of multidrug-resistant strains. Finding new effective treatments against multidrug resistant [strains](#) remains an important priority."

More information: *Genome Research* (2017). [DOI: 10.1101/gr.216606.116](#)

Provided by Wellcome Trust Sanger Institute

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